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This is the author's manuscript

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141 FF P

Tendon vibration combined with rTMS can reinforce a pattern of unbalanced M1 excitability between agonist and antagonist muscles

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Aim: The aim of the study was to verify whether it is possible to reinforce a pattern of unbalanced primary motor cortex (M1) excitability between agonist and antagonist muscles by combining proprioceptive vibration with a concomitant facilitatory rTMS (repetitive Transcranial Magnetic Stimulation) protocol.

Method: Eighteen subjects were recruited for this study. M1 excitability was evaluated by motor evoked potentials (MEPs) measured on Extensor Carpi Radialis muscle (ECR group, N = 10) and on Flexor Carpi Radialis muscle (FCR group, N = 8) after transcranial magnetic stimulation (TMS) on M1 of both muscles. The tendon of the FCR muscle was vibrated for 2 min (80 Hz frequency). 15 MEPs were recorded before the vibration (PRE), and 15 MEPs 15 and 30 min after the vibration (POST 15, POST 30). The rTMS protocol consisted of a train of 600 stimuli at 90 % of active motor threshold (AMT) of the ECR and FCR muscles with a frequency of 5 Hz.

We designed four protocols:

1. Vibration: 2 min of vibration without rTMS.
2. rTMS on ECR and FCR hot spot without vibration.
3. Vibration + rTMS on ECR hot spot.
4. Vibration + rTMS on FCR hot spot.

Results: We found that the protocols 1 and 2 did not induce statistically significant changes in M1 excitability. Considering the ECR group, in the protocol 3, M1 excitability showed a significant decrease compared with the baseline both in POST 15 and in POST 30 ($p = 0.01$), while the protocol 4 caused a statistically significant increase in M1 excitability respect to the baseline in POST 15 ($p = 0.05$) and a trend of diminution in POST 30. Considering FCR group in the protocol 3 data showed a statistically significant increase in M1 excitability respect to the baseline both in POST 15 and in POST 30 ($p = 0.05$). Protocol 4 did not induce any significant difference in M1 excitability.

Conclusion: Our finding highlights the close relationship between proprioception, the sensory feedback mechanism for motor control, and the excitability of cortical motor areas. We demonstrated that combining tendon vibration with a conditioning facilitatory rTMS protocol induces a pattern of unbalanced M1 excitability between the vibrated muscle and its antagonist that persisted up to 30 min and is greater than that observed when vibration is administered alone.

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142 FF P

RSA, CMJ, Leger, 10 m sprint responses to pre-season training in semi-professional soccer players

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Aim: The aim of this study was to analyze RSA, CMJ, Leger, 10 m sprint responses to Pre-season Training in Semi-Professional Soccer Players (SPSP). Considering that numerous studies highlighted the combination of high levels of physical, technical and tactical skills during a soccer match, the cure of physical training pose a particular attention on training load that generally increases up to 2.4 times during the pre-season period compared with the in-season.

Methods: Six SPSP (age 23 ± 7 years, BMI 23.3 ± 1.8) were requested to perform aerobic training over an 8-week period on alternate days with the functional strength training sessions and sprint training drills as prescribed by the coaches and strength and conditioning staff. Repeated Sprint Ability [RSA, total time (TT) and percentage of fatigue index (%FI)], Leger, 10 m sprint and Counter Movement Jump (CMJ) tests, were performed before and after pre-season soccer training. ANOVA for repeated measures was conducted to assess differences ($p < 0.05$) with respect to pre seasonal training. Correlation was calculated between the percentage of variation (Δ) of each test.

Results: Compared to the values recorded before the pre-season, improvement of Leger (3 %) and %FI (17.6 %) and a deterioration of TT (10 %), 10 m sprint (0.2 %) and CMJ (2.4 %) were found. In addition, we have found a main effect between before and after pre-seasonal training in TT ($F_{(1,4)} = 60.2$; $p = 0.001$) and Leger ($F_{(1,5)} = 25$; $p < 0.005$). Δ CMJ showed very large correlation with Δ Leger ($r = -0.88$) and nearly perfect with Δ %FI ($r = 0.93$); while Δ Leger was largely correlated with Δ %FI ($r = -0.69$).

Conclusion: Given that the cure of the physical preparation is considered as an important element in order to influence the final soccer game result, this study want to be useful information for the coach in order to maximize the best physical condition of the whole team relative to the beginning of the regular season.

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